REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	12/08/76	

4. TITLE AND SUBTITLE
DETERMINATION OF DECONTAMINATION CRITERIA, DIMP AND DCPD (U)

5. FUNDING NUMBERS
DAMD 17 75 C 5069

6. AUTHOR(S)
O'DONOVAN, P.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
AEROJET ORDNANCE & MANUFACTURING COMPANY
DOWNEY, CA

8. PERFORMING ORGANIZATION REPORT NUMBER
81320R16

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(S)
FORT DETRICK (FREDERICK, MD.)
FREDERICK, MD

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)
THIS IS A PROGRESS REPORT ON AEROJET'S STUDIES OF EXPERIMENTS CURRENTLY UNDERWAY (E.G. PLANT GROWTH & DIMP IN TWO MODES OF APPLICATION TO SOIL ARE CONTINUING. EVAPORATION SEEMED TO BE A SIGNIFICANT FACTOR IN THE LOSS OF DCPD FROM SOIL SAMPLES. TO DETERMINE THAT THIS IS TRUE EVAPORATION, SEVERAL SIMPLE EXPERIMENTS WERE PERFORMED. THE STATISTICAL TREATMENT OF THE PLANT YIELDS FROM THE 1, 8 AND 20 PPM DIMP GROWTH TESTS AWAITS COMPLETION OF THE SUGAR BEET & CARROT HARVEST.

14. SUBJECT TERMS
CONTAMINANTS, FLORA, SOIL, CHEMICALS, LYSIMETER

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED			

81320R16
ORIGINAL

AEROJET ORDNANCE AND MANUFACTURING COMPANY
9236 East Hall Road
Downey, California 90241

DETERMINATION OF DECONTAMINATION CRITERIA

DIMP AND DCPD (U)

Report No. 1953-01(16)MP

Contract DAMD-17-75-C-5069

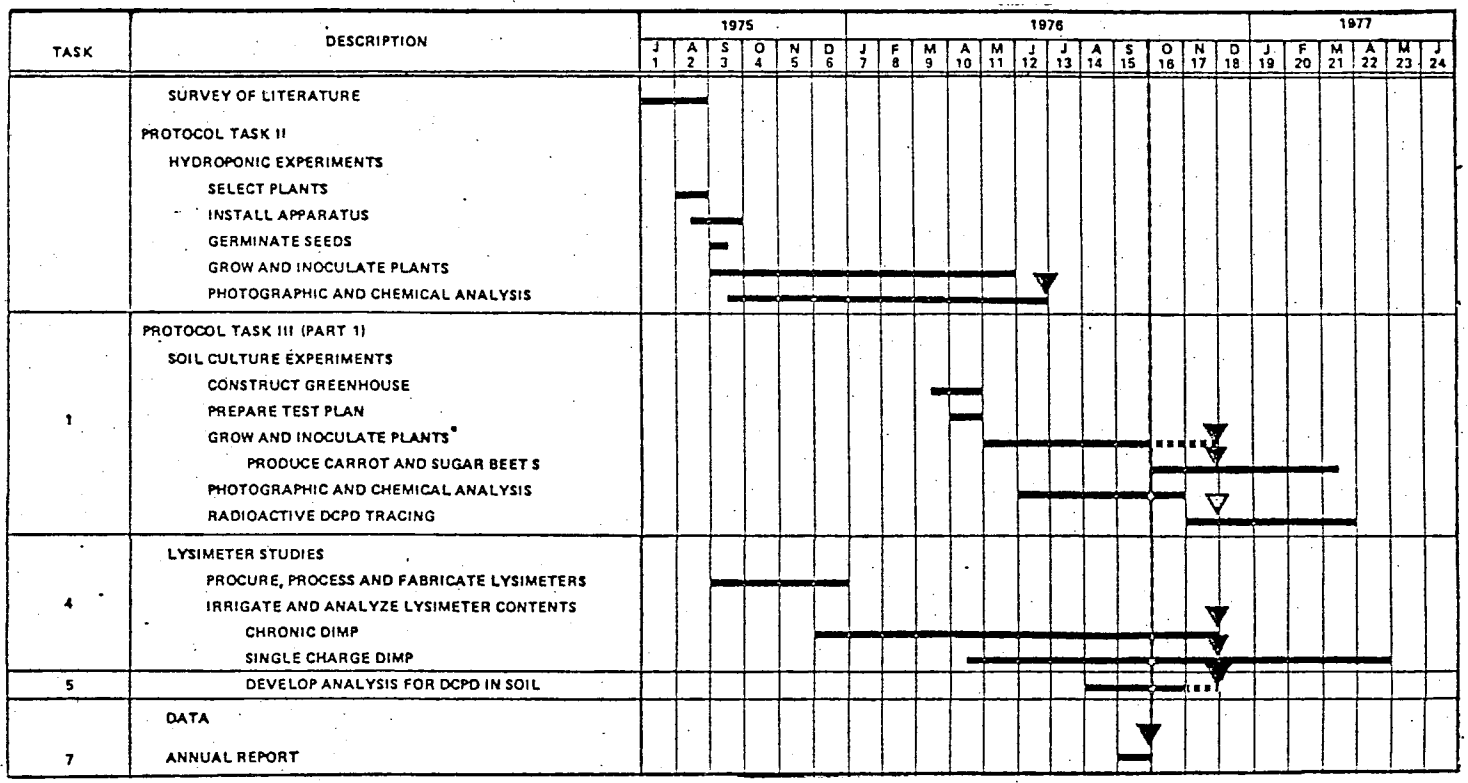
To

U. S. ARMY, Ft. Detrick
Fredrick, Maryland 21701

Prepared by: P. A. O'Donovan
P. A. O'Donovan

Date: 8 December 1976

No. of Pages: 16



*POSSIBLE SLIPPAGE POINT. ADJUSTMENT OF CONTAMINANT AT THIS POINT SHIFTS ALL FOLLOWING PLANT WORK TO THE RIGHT.

▼ - Satisfactory Progress-On Schedule

▽ - Slippage of schedule -
a. Reduction of level of effort caused postponement.

Determination of Decontamination Criteria -- DIMP and DCPD
Research Task Schedule

1953-01(16)MP

Progress on items proposed for action during November 1976 is discussed in the following paragraphs.

FULL SCALE LYSIMETER TESTS

Lysimeter tests designed to study the mobility of water solutions of DIMP (diisopropyl methyl phosphonate) in two modes of application to soil are continuing. The soil under investigation consists of five types including:

Chino	-	sandy clay loam
Brawley	-	silty clay
Ventura	-	clay loam
Fullerton	-	sandy loam
Walnut	-	clay loam

Each of the soil types is loaded into its respective lysimeter which consists of a five-foot deep steel cylinder, epoxy coated on the inside, fitted with an array of porous ceramic tensiometer samplers which are embedded in the soil at regular intervals. These samplers allow liquid percolating down through the soil bed to be sampled by applying a light vacuum to the tensiometer tubing.

There are two lysimeters prepared for each type of soil. In one group (Group 1) the soil is irrigated every two weeks with two inches (12, 887 ml) of distilled water containing 20 ppm (parts per million) DIMP. In the other group (Group 2) the top one foot depth of soil was intimately mixed with enough DIMP to result in a soil concentration of 20 ppm.

In addition to the tensiometer water samples the soil is sampled in six-inch depth increments for the full depth of the lysimeter. These samples are also analyzed for DIMP content. Recent tensiometer and soil analytical results are shown in Tables 1 and 2 and Tables 3 and 4, respectively.

The tensiometer water samples are consistent, in general, with their previous behavior. The Group 1 samples show DIMP distributed throughout all of the soil area. The DIMP contents of the 60-inch drain samples from Group 1 appear to be equilibrating around the 20 ppm area. Figures 1(a), 1(b), 1(c), 1(d) and 1(e) reflect the current data for these samples.

The Group 2 soil samples are following the established trend quite regularly. No DIMP was detectable in any samples shallower than 18 inches below the surface. All samples except Brawley were showing DIMP in the lowest level (54"-60") and the Fullerton sample showed significant amounts in the lowest layer (14.8 ppm).

The Group 2 water samples at 217 days appear to be generally consistent with previous assays. The Fullerton lysimeter has had DIMP appearing in the 60-inch sample for the last three weekly analyses. This is the first significant showing of any DIMP in a Group 2 drain.

Drainage ratio, the volume of liquid drained out of the lysimeter at the 60-inch level divided by the volume of liquid poured in at the top, is a measure of the amount of water which did not evaporate during the 14-day

Table 1

DIMP Content of Tensiometer Water Samples (Group 1 East)

Depth	Ventura	Chino	Fullerton	Walnut	Brawley
		ppm @ 335 days			
6"	*	17.7	17.6	13.2	24.4
18"	5.3	11.6	10.5	13.4	21.5
30"	7.5	14.3	11.6	8.4	17.4
42"	8.4	17.4	10.1	7.7	13.4
54"	8.2	17.9	7.8	8.2	11.4
60"	19.9	20.2	17.7	23.9	21.4

* No sample

Table 2

DIMP Content of Tensiometer Water Samples (Group 2 West)

Depth	Ventura	Chino	Fullerton	Walnut	Brawley
		ppm @ 189 days			
6"	*	*	*	*	*
18"	0.7	46.5	9.5	*	9.3
30"	80.9	74.1	37.5	43.7	68.1
42"	**	47.4	39.4	**	4.5
54"	0.7	*	**	*	*
60"	*	*	29.5	0.7	*

* <0.1 ppm

** No sample

Table 3

DIMP Content of Soil Samples (ppm) Group 1 East (328 days)

Depth	Ventura	Chino	Fullerton	Walnut	Brawley
0 (surface)*	41.1	56.2	37.7	20.7	17.5
0 - 6"	9.3	14.0	6.7	10.6	14.4
6 - 12"	5.0	4.6	11.0	6.1	12.1
12 - 18"	*	4.9	7.8	5.1	13.3
18 - 24"	*	4.6	14.5	5.4	11.2
24 - 30"	*	3.9	8.7	5.4	12.9
30 - 36"	*	3.5	9.6	8.0	16.5
36 - 42"	*	2.2	7.2	4.8	10.0
42 - 48"	*	3.4	12.6	8.5	5.7
48 - 54"	*	2.4	4.9	7.9	4.0
54 - 60"	*	3.2	7.8	5.0	3.0

* < 0.1 ppm

Table 4

DIMP Content of Soil Samples (ppm) Group 2 West (188 days)

Depth	Ventura	Chino	Fullerton	Walnut	Brawley
0 (surface) *	*	*	*	*	*
0 - 6"	*	*	*	*	*
6 - 12"	*	*	*	*	*
12 - 18"	*	*	*	*	*
18 - 24"	1.6	8.6	*	*	*
24 - 30"	14.4	5.6	3.1	*	5.9
30 - 36"	25.1	5.8	12.8	1.1	19.4
36 - 42"	38.7	10.3	10.2	6.0	5.4
42 - 48"	7.1	9.7	9.9	25.3	2.6
48 - 54"	4.2	3.8	9.9	10.5	0.8
54 - 60"	3.7	1.5	14.8	2.4	*

* <0.1 ppm

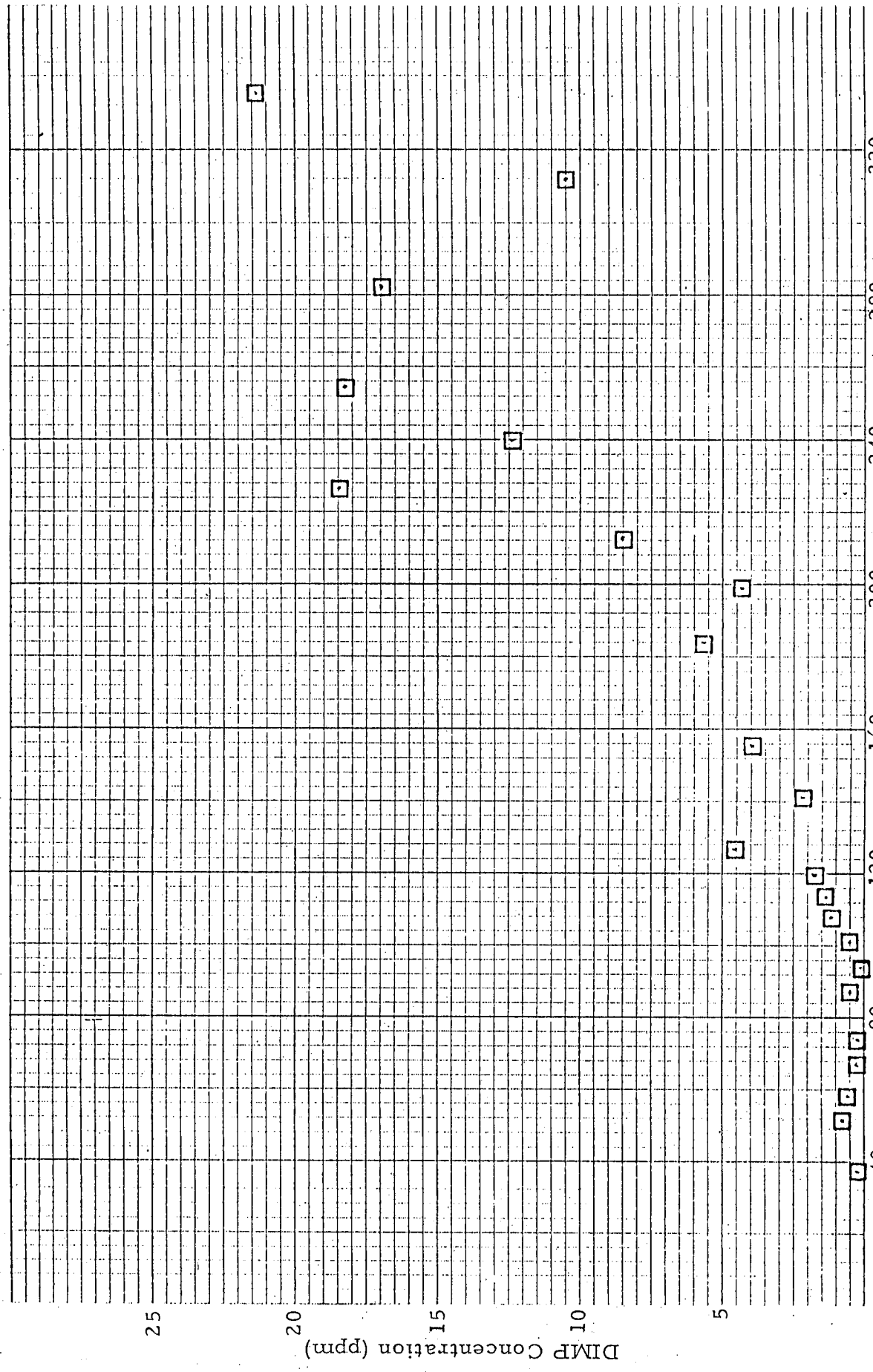


Figure 1(a). Concentration of DIMP in 60 Inch Sample of Water
Brawley Lysimeter

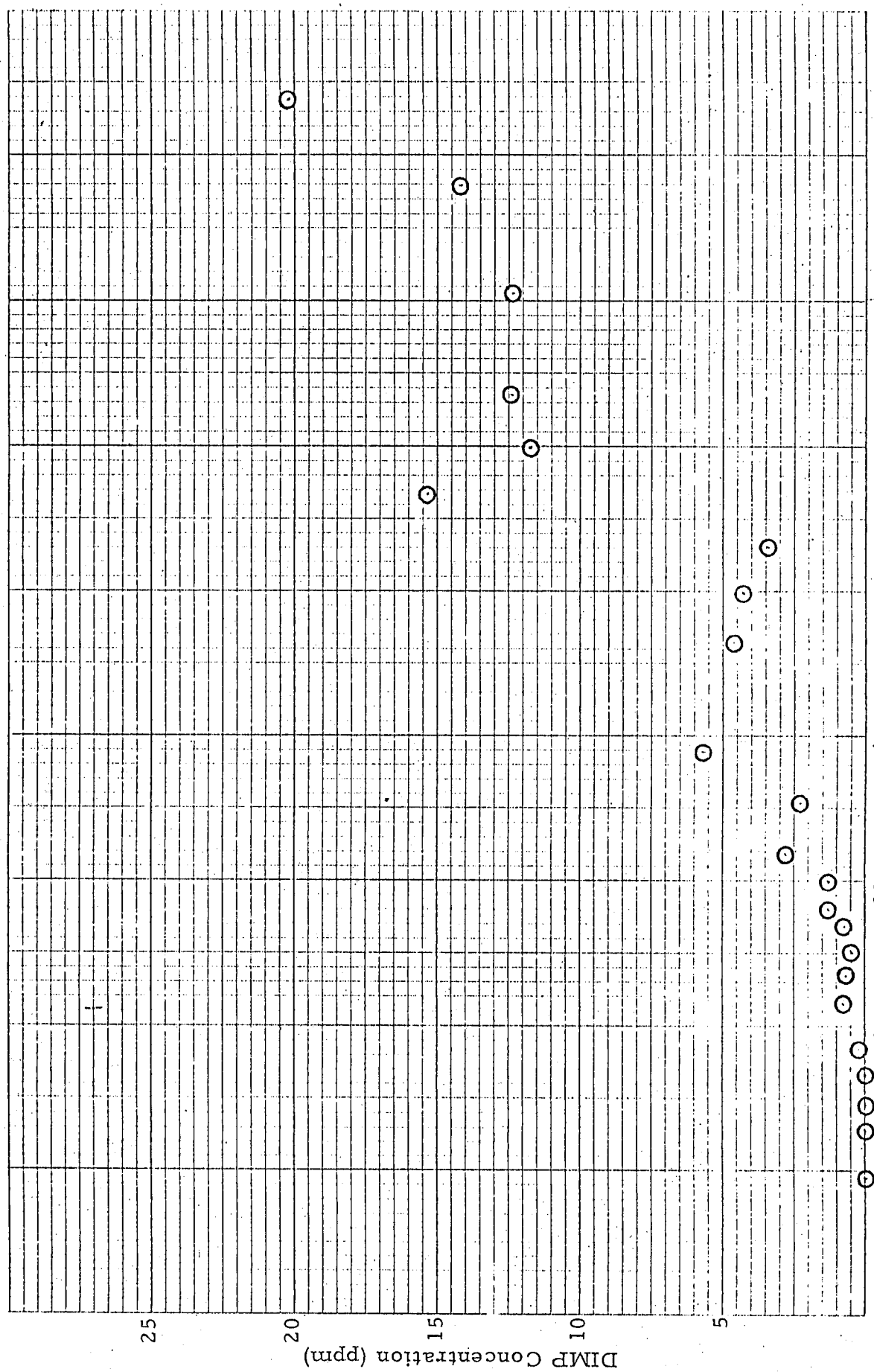


Figure 1(b). Concentration of DIMP in 60 Inch Sample of Water
Chino Lysimeter

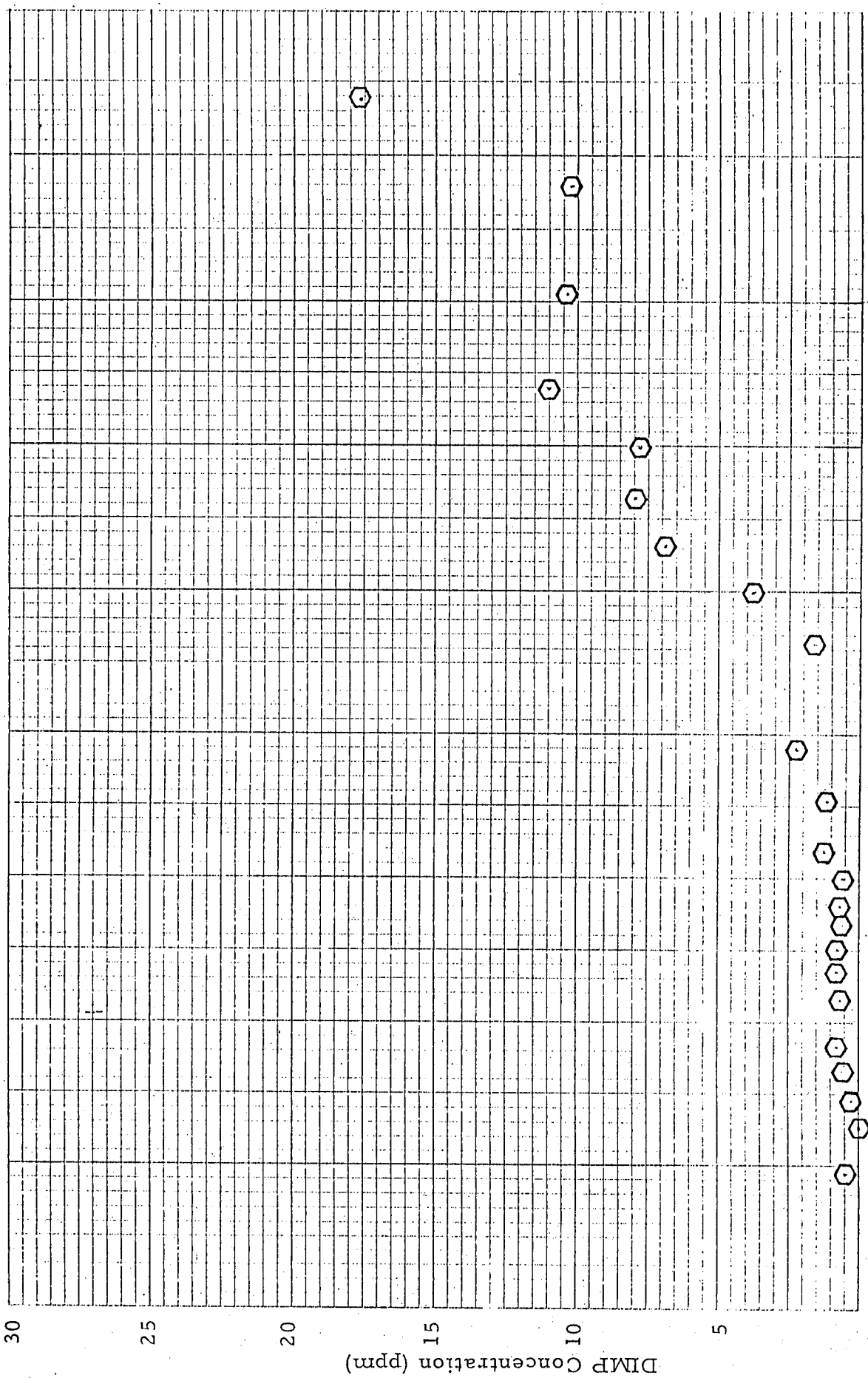


Figure 1(c). Concentration of DIMP in 60 Inch Sample of Water
Fullerton Lysimeter

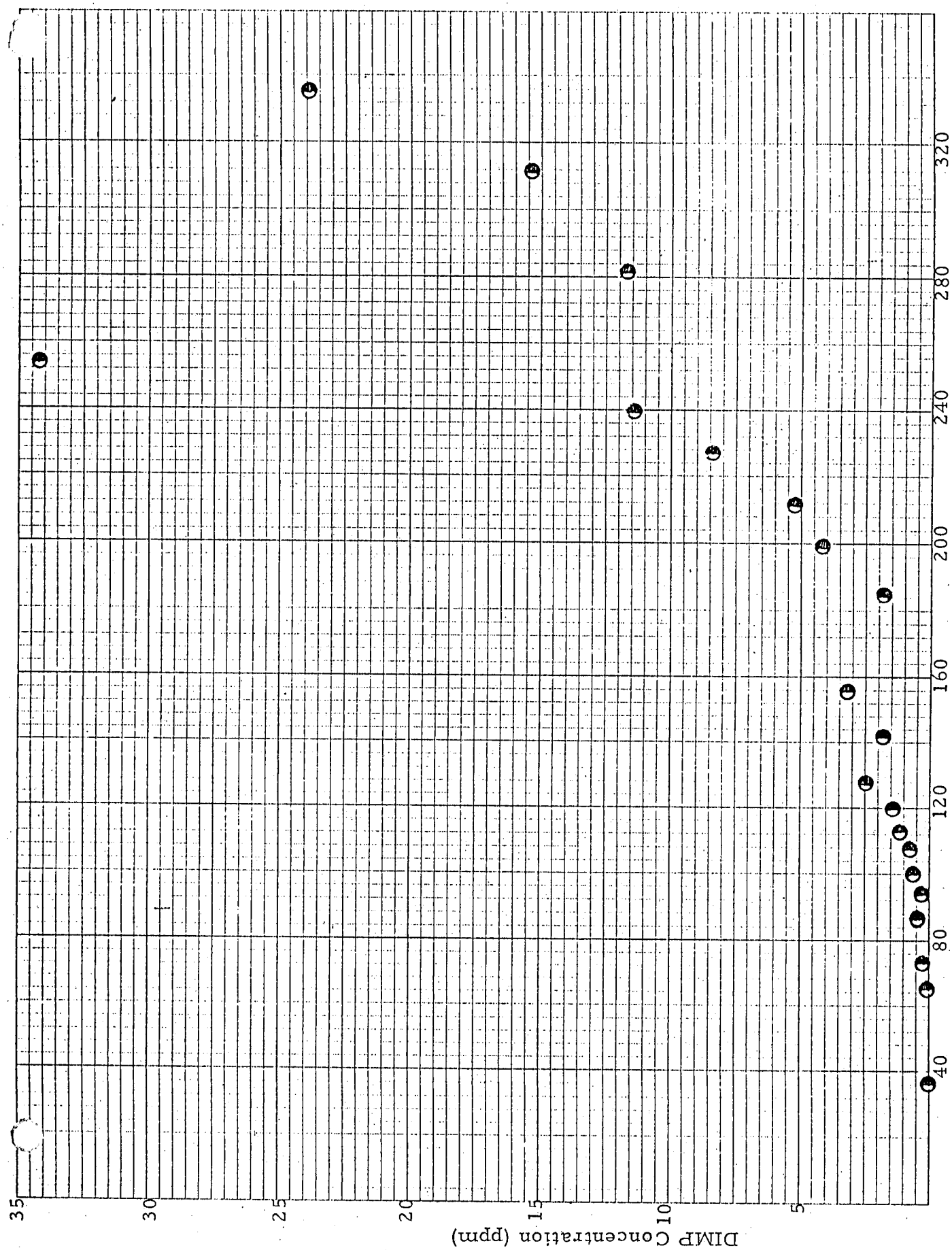


Figure 1(d). Concentration of DIMP in 60 Inch Sample of Water
Walnut Lysimeter

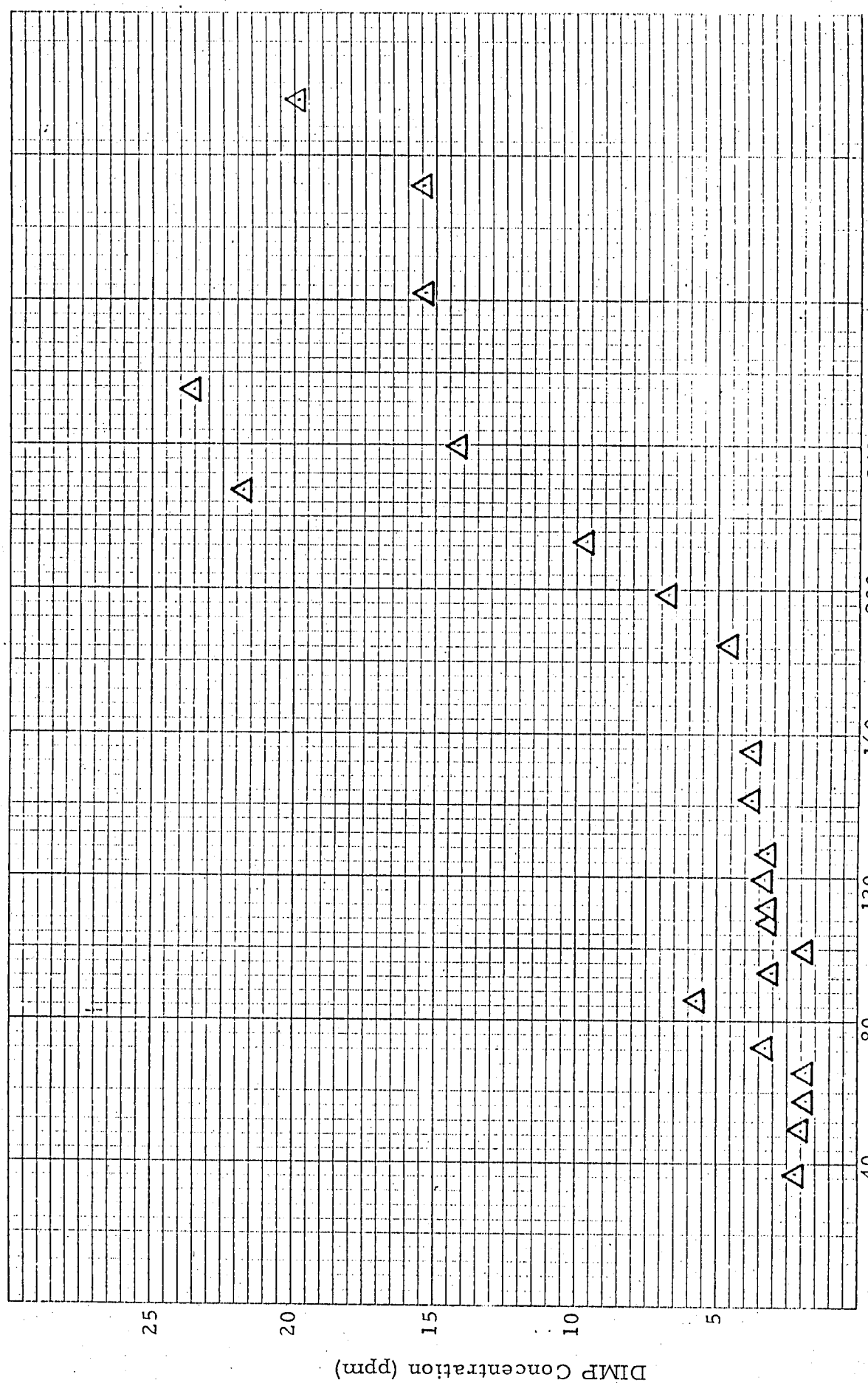


Figure 1(e). Concentration of DIMP in 60 Inch Sample of Water
Ventura Lysimeter

lysimeter irrigation period. Figure 2 is a plot of the average drainage ratios for Group 1 and Group 2. In order to determine if the evaporations implied by the drainage ratios were in the realm of credibility an evaporation test was run during this reporting period. In this test a 2-inch layer of distilled water was placed on the surface of the unused by saturated lysimeter adjoining the test units. This water completely evaporated to return the system to the starting condition in 210 hours. This is equivalent to 8-3/4 days, well within the 14 days available for sample evaporation in the test cases. This data is compatible with two similar tests run in recent months.

DCPD ANALYSIS IN SOILS

As discussed in last month's report (1953-01(15)MP) evaporation seemed to be a significant factor in the loss of DCPD (dicyclopentadiene) from soil samples. To determine that this is true evaporation and not a chemical phenomenon such as oxidation, polymerization, etc., several simple experiments were performed. In one such test 186.2 mg DCPD were placed on an uncovered pyrex watchglass and left standing at 24°C on the laboratory bench. The mass of DCPD remaining on the watchglass at various times was determined. This data is shown in Table 5. A plot of the amount of chemical present versus time is shown in Figure 3. This indicates that at these conditions in approximately two hours all of the DCPD had evaporated.

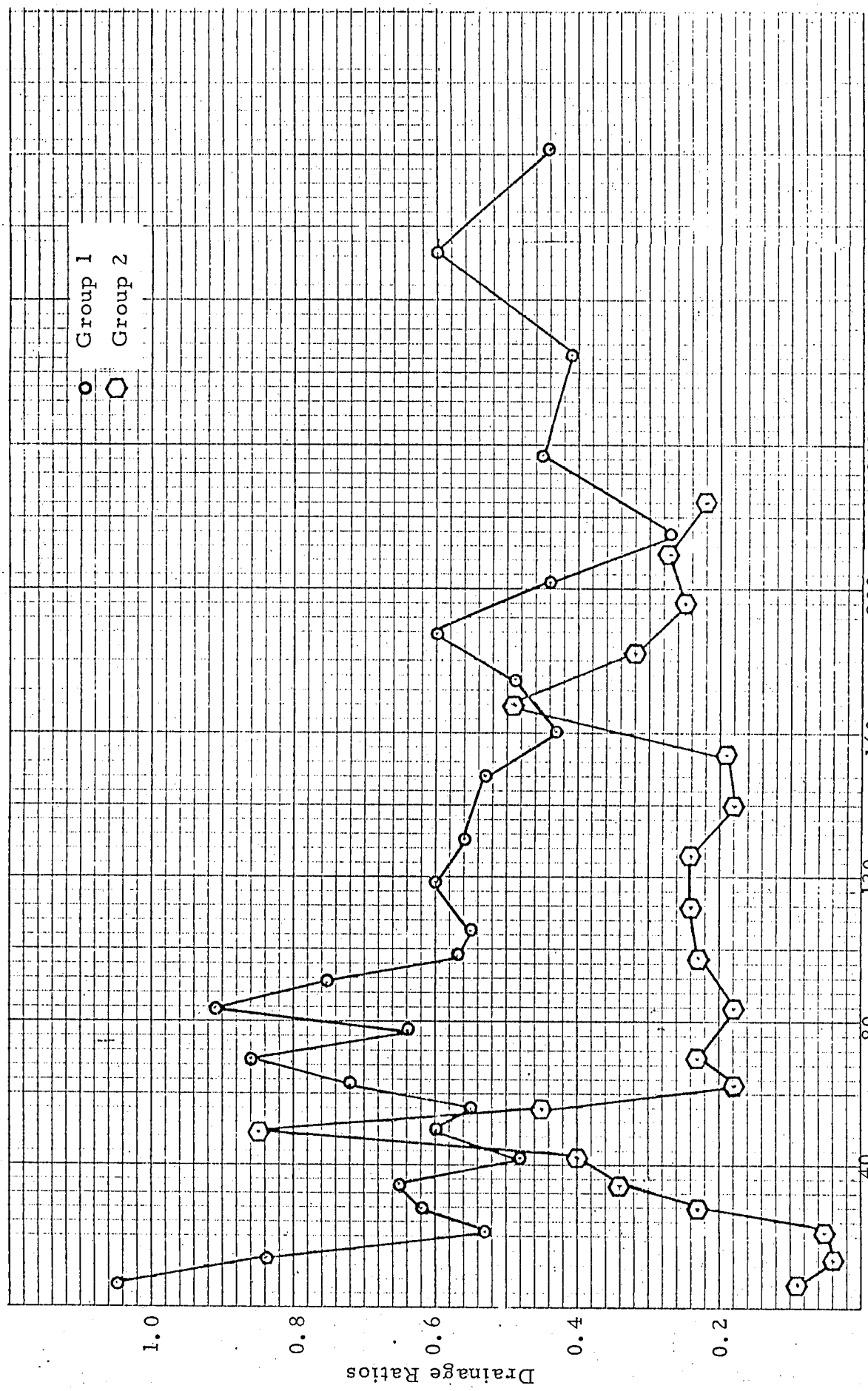


Figure 2. Drainage Ratios of Various Soils in Full Scale Lysimeters
Average of All Samples Within the Groups

TABLE 5.

Evaporation of DCPD at 24°C

Time (min)	Wt of DCPD Remaining (mg)	% DCPD Remaining
0	186.2	100.0
17	158.3	85.0
32	133.3	71.5
47	113.7	61.1
66	87.7	47.1
82	65.5	35.2
101	41.3	22.2
117	23.0	12.4
127	5.1	2.7

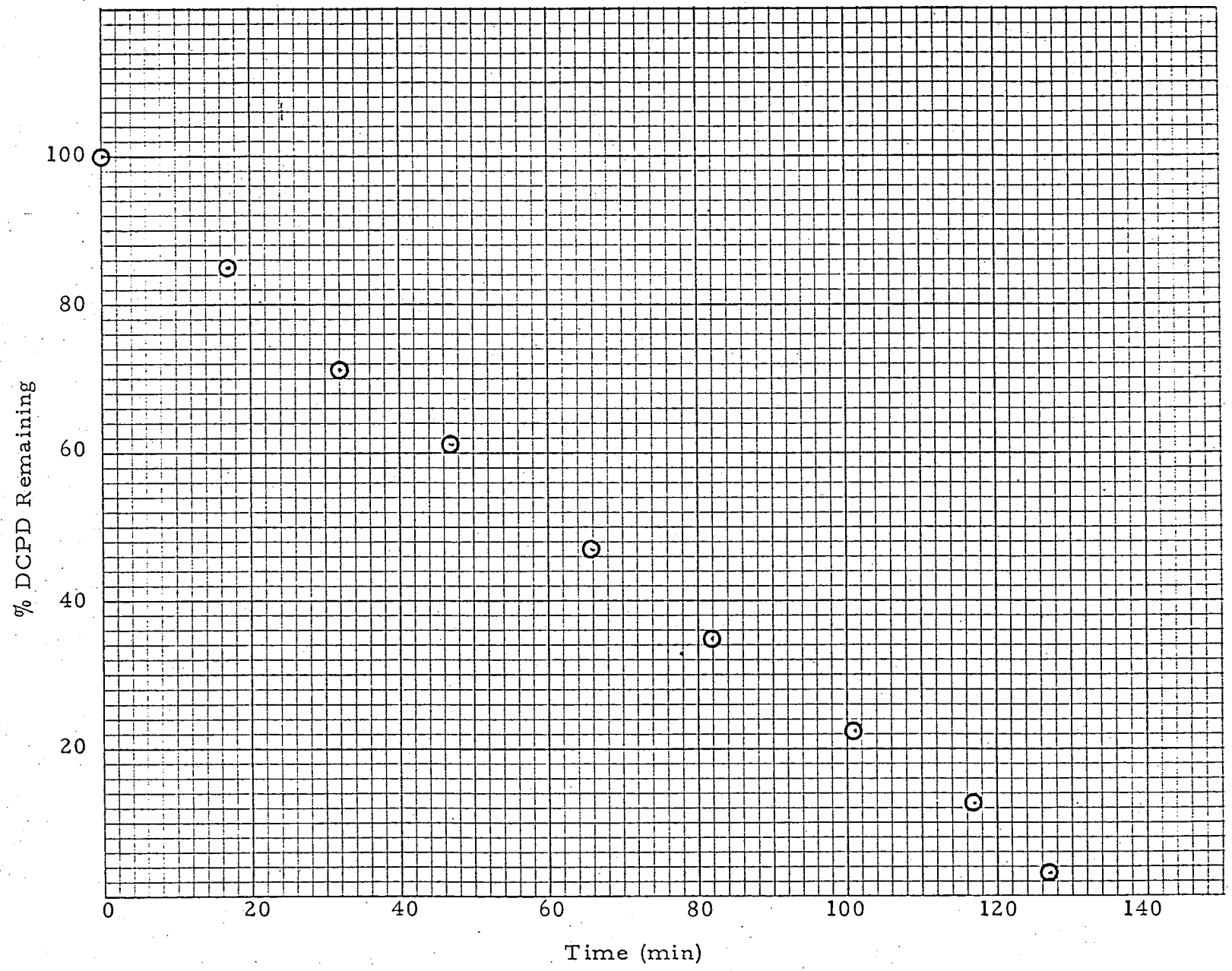


Figure 3. Evaporation of DCPD From Watchglass at 24°C

In an attempt to have greater than normal precautions against evaporative loss of the DCPD from standard soil samples, the following procedure was used. The dry soil sample, 256 grams of Fullerton top soil, was weighed into a tumbler jar. 94.4 milligrams of DCPD sealed into a glass ampoule (Jesse Petty Glass Specialties, Tallahassee, Florida 32303) was placed inside the jar, the jar sealed and the ampoule broken by agitation followed by tumbling of the jar for one hour to mix the contents. The entire contents of the jar were then extracted with 128 milliliters of hexane. The yield of DCPD obtained in hexane was 53.3% of the added amount.

The possibility was considered that the soil in some way catalyzed or reacted with the DCPD resulting in decomposition of the chemical. To provide a substrate with different, less reactive, characteristics than soil, the previous experiment was repeated substituting glass "micro beads" for the soil (Superbrite Glass Beads, 3M Company, St. Paul, Minnesota). 150 micrograms were recovered per gram of glass beads from an added DCPD quantity of 369 micrograms for a recovery efficiency of 46.9%. This is comparable to the 53.5% from the Fullerton soil.

A similar mix of DCPD with glass beads was handled in the laboratory for an estimated hour's time while weighing small samples from it. The bulk of this material was subsequently extracted with hexane and this analyzed. The yield of DCPD from this operation was 19.2%. The inference from this analytical data and previous data and observations is that the evaporation of DCPD is significant. A more elaborate analytical procedure would be required for the DCPD to make certain that no evaporative losses occurred in the laboratory. Since the bulk samples to be analyzed (lysimeter soil, irrigation water, etc.) are not protected against evaporation the relative value of such precise analyses remains to be determined. Further investigations of these analyses will not be made at this time.

SOIL CULTURE EXPERIMENTS

The statistical treatment of the plant yields from the 1, 8 and 20 ppm DIMP growth tests awaits completion of the sugar beet and carrot harvest. The range finding tests are also continuing in soil. As of the last report the apparent effective dose for DIMP is still holding at 50 ppm which shows minimal phytotoxicity symptoms at that level.

PROPOSED ACTIVITY FOR DECEMBER 1976

- Harvest carrots and sugar beets from the 1, 8, and 20 ppm phytotoxicity test areas. Subject yield data to statistical analysis.
- Chemically analyze pot soil and plant material from above areas.
- Continue treatment and analysis of lysimeter soil and water samples.
- Continue the gross range finding effectiveness level experiments for DIMP and DCPD in soils.
- Finalize equipment set-up for radioactive DCPD evaporation/ decomposition experiments.